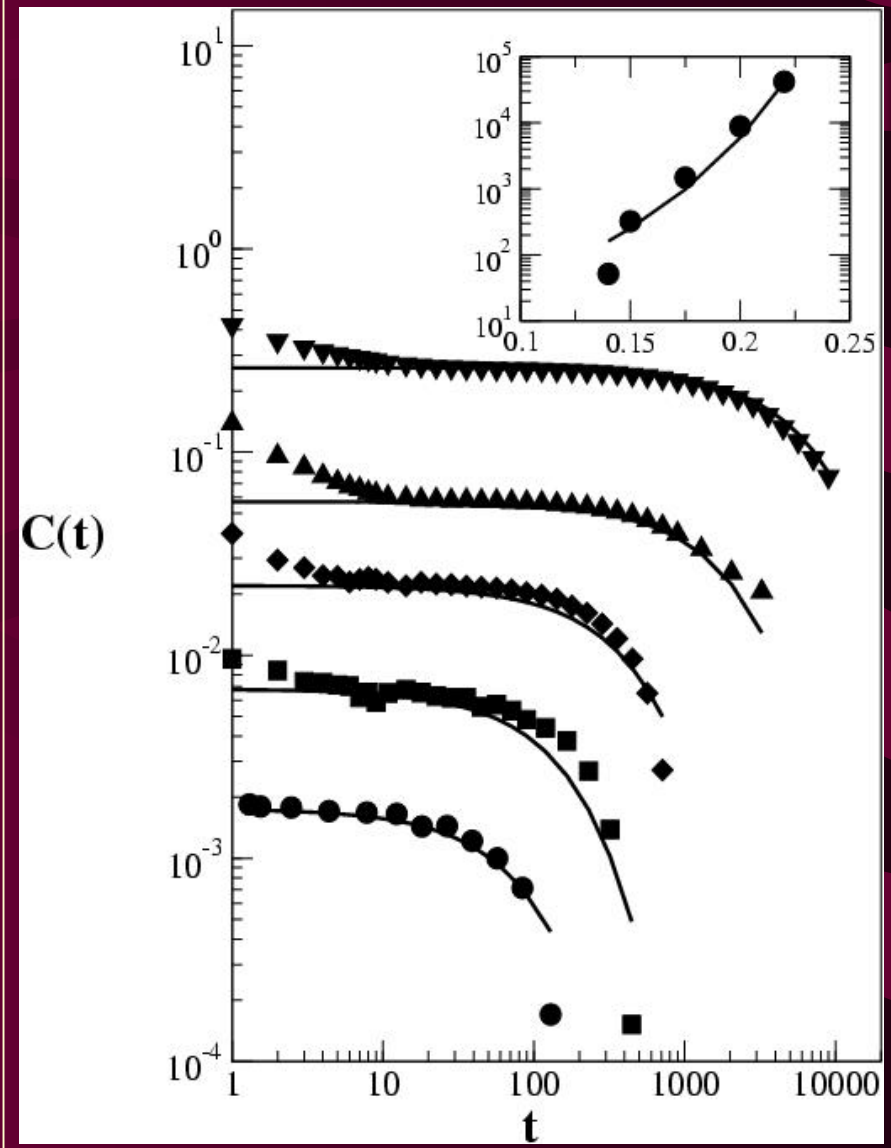
Dynamical Models with Anomalous Ordering Kinetics
Bulbul Chakraborty, DMR Award# 9815986

The exact nature of the glass transition in a supercooled liquids is still an enigma. Timescales associated with relaxations occurring in the liquid grow by several orders of magnitude as the temperature is decreased by a mere factor of two or so. What makes this slowing down even more amazing is the absence of any observable structural changes. It seems as if the liquid just stops flowing. Recent experiments have uncovered the presence of dynamical heterogeneities in supercooled liquids; setting it apart from the homogeneous, high-temperature liquid. These observations raised the intriguing possibility that extended spatial structures are the key to understanding the slow dynamics in supercooled liquids.

Recently, we have studied simple lattice models which exhibit the same phenomenology as supercooled liquids undergoing the glass transition as depicted by the figure on the right. The relaxation, C(t), is non-exponential as in supercooled liquids and the “typical” timescale diverges exponentially (inset of the figure).

The origin of this dynamical behavior can be traced back to the jamming of extended spatial structures which occur naturally in the lattice models (Phys. Rev. E65, 036119 (2002) and cond-mat/ 0112281). This analysis lends credence to the idea that the slow dynamics in liquids is intimately related to the presence of the dynamical heterogeneities.



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The origin of the slow dynamics in the lattice model can be traced back to the jamming of extended spatial structures which occur naturally in these models and are depicted schematically in the above figure. Removal or insertion of these structures involve energy and entropy barriers, respectively and lead to the exponential slowing down of the dynamics as a ordering transition is approached (Phys. Rev. E65, 036119 (2002) and cond-mat/ 0112281))This analysis lends credence to the idea that the slow dynamics in liquids is intimately related to the presence of the dynamical heterogeneities and paints a possible scenario of the glass transition.

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